

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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## Pearson Edexcel Level 3 GCE

Time 1 hour 30 minutes

Paper  
reference

8PH0/01

### Physics

Advanced Subsidiary

PAPER 1: Core Physics I



#### You must have:

Scientific calculator, ruler, protractor

Total Marks

#### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions in Sections A and B.
- Answer the questions in the spaces provided
  - *there may be more space than you need.*

#### Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  - *use this as a guide as to how much time to spend on each question.*
- In the question marked with an **asterisk** (\*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.
- The list of data, formulae and relationships is printed at the end of this booklet.

#### Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- You are advised to show your working in calculations including units where appropriate.

Turn over ►

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Q1/1/1/e2/1



P 6 9 4 4 0 R A 0 1 3 2



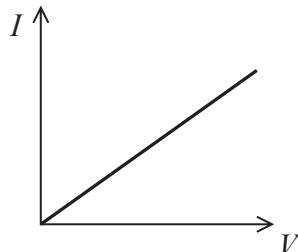
Pearson

## SECTION A

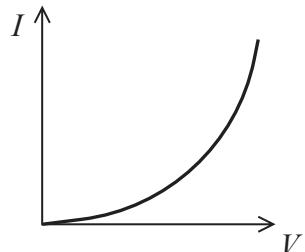
Answer ALL questions.

All multiple choice questions must be answered with a cross in the box  for the correct answer from A to D. If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

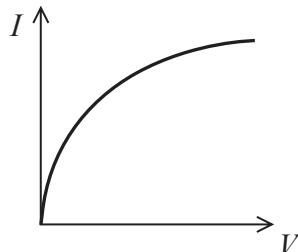
1 Which of the following graphs shows how the current  $I$  through a thermistor varies with the potential difference  $V$  across the thermistor?



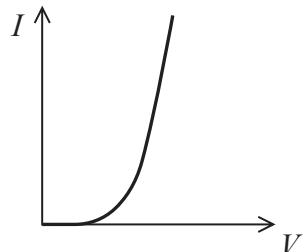
A



B



C



D

- A
- B
- C
- D

(Total for Question 1 = 1 mark)



2 Which of the following is the SI base unit for resistance?

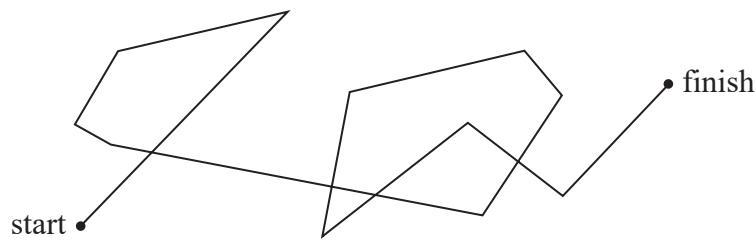
- A  $\Omega$
- B  $\text{VA}^{-1}$
- C  $\text{kg m}^2 \text{s}^{-3} \text{A}^{-2}$
- D  $\text{kg m}^2 \text{s}^{-1} \text{C}^{-2}$

(Total for Question 2 = 1 mark)

3 The diagram shows the path of a pollen particle on the surface of water as it is hit by water molecules.

Scale

1 cm : 0.5 mm



Which of the following is the magnitude of the displacement of the pollen particle in mm?

- A 260
- B 80
- C 13
- D 4

(Total for Question 3 = 1 mark)

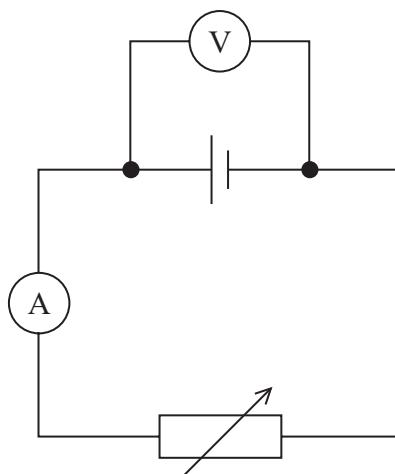
4 A conductor has a resistance  $R$ . A constant potential difference is applied across the conductor. The drift velocity of the charge carriers in the conductor is  $v$ .

Which of the following is the relationship between  $R$  and  $v$ ?

- A  $v \propto R$
- B  $v \propto \sqrt{R}$
- C  $v \propto \frac{1}{R}$
- D  $v \propto \frac{1}{\sqrt{R}}$

(Total for Question 4 = 1 mark)

5 A variable resistor is connected in a circuit as shown. The cell has internal resistance.



The resistance of the variable resistor is increased.

Which row of the table is correct?

	<b>Ammeter reading</b>	<b>Voltmeter reading</b>
<input checked="" type="checkbox"/> A	increases	increases
<input checked="" type="checkbox"/> B	increases	decreases
<input checked="" type="checkbox"/> C	decreases	increases
<input checked="" type="checkbox"/> D	decreases	decreases

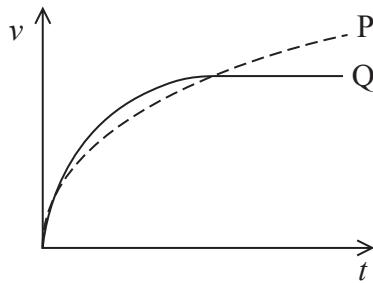
(Total for Question 5 = 1 mark)



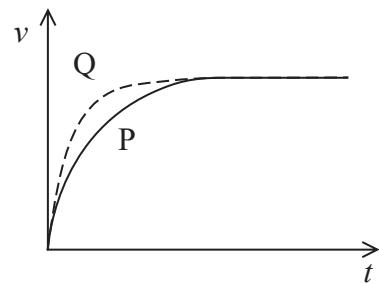
6 Two identical lorries, P and Q, carry different loads inside them so that the total mass of P is greater than the total mass of Q.

P and Q start from rest along the same road. The forward force from the engine of each lorry is the same.

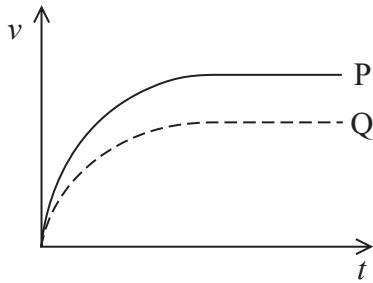
Which of the following graphs correctly shows how velocity  $v$  varies with time  $t$  for the two lorries?



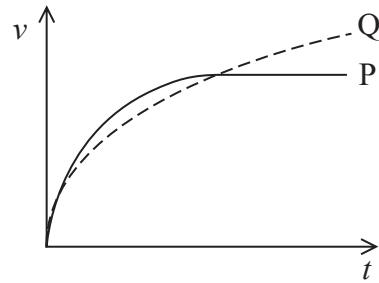
A



B



C



D

- A
- B
- C
- D

(Total for Question 6 = 1 mark)

7 A cable is used to pull a mass of 2.5 kg vertically upwards with an acceleration of  $4.3 \text{ m s}^{-2}$ .

Which of the following expressions gives the tension in the cable in N?

- A  $2.5 \times 4.3$
- B  $(2.5 \times 4.3) - (2.5 \times 9.81)$
- C  $(2.5 \times 4.3) + (2.5 \times 9.81)$
- D  $2.5 \times 9.81$

(Total for Question 7 = 1 mark)

8 A power station provides electrical power at a mean rate of 3500 MW.

Which of the following gives the best estimate of the energy provided to consumers over a period of a year?

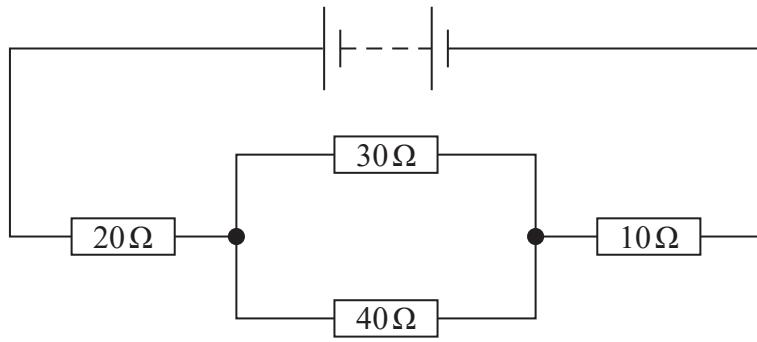
$$1 \text{ year} = 3.2 \times 10^7 \text{ s}$$

- A  $1 \times 10^6 \text{ J}$
- B  $1 \times 10^{11} \text{ J}$
- C  $1 \times 10^{13} \text{ J}$
- D  $1 \times 10^{17} \text{ J}$

(Total for Question 8 = 1 mark)



9 A circuit was constructed as shown.



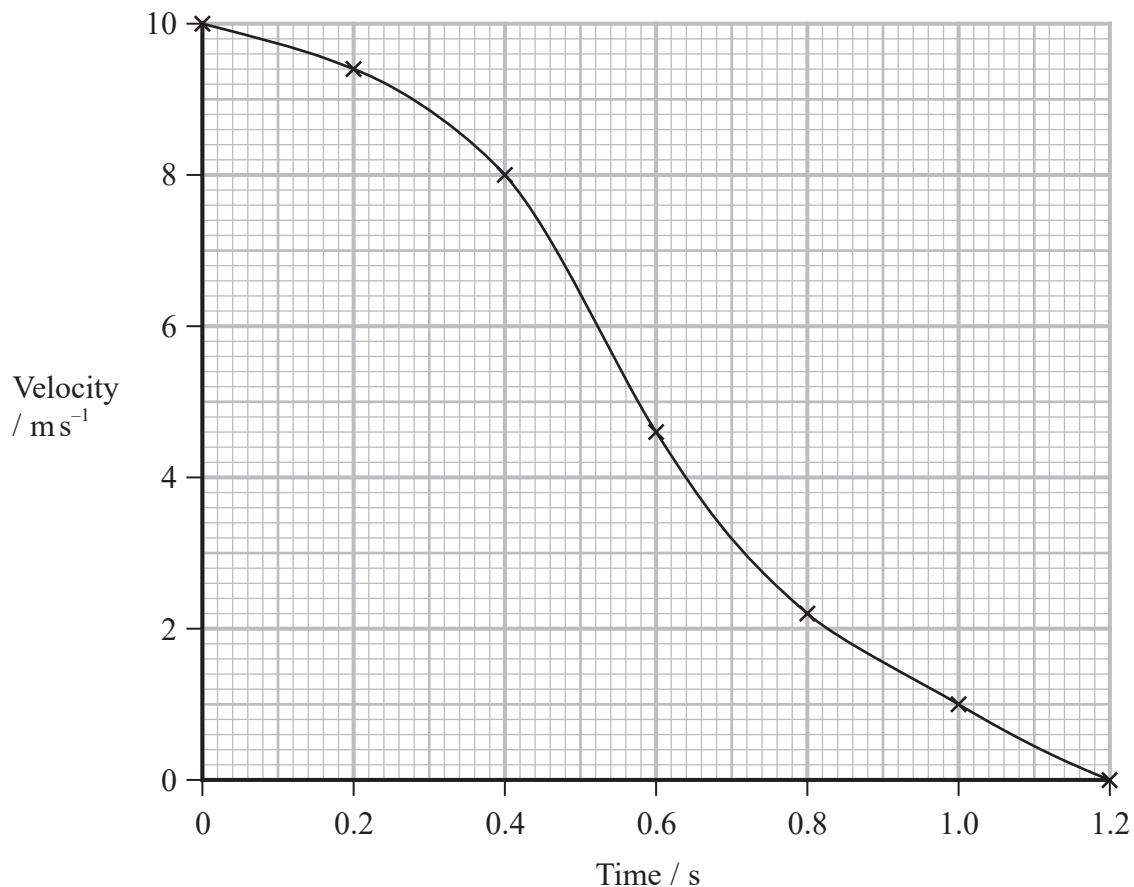
Calculate the total resistance of the resistors in the circuit.

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Total resistance = .....

**(Total for Question 9 = 3 marks)**

10 A sprinter crossed the finish line of a race and then decelerated to rest. The graph shows how the velocity of the sprinter varied with time once the sprinter had crossed the finish line.



Determine the distance travelled by the sprinter whilst decelerating to rest.

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Distance = ..... m

(Total for Question 10 = 3 marks)



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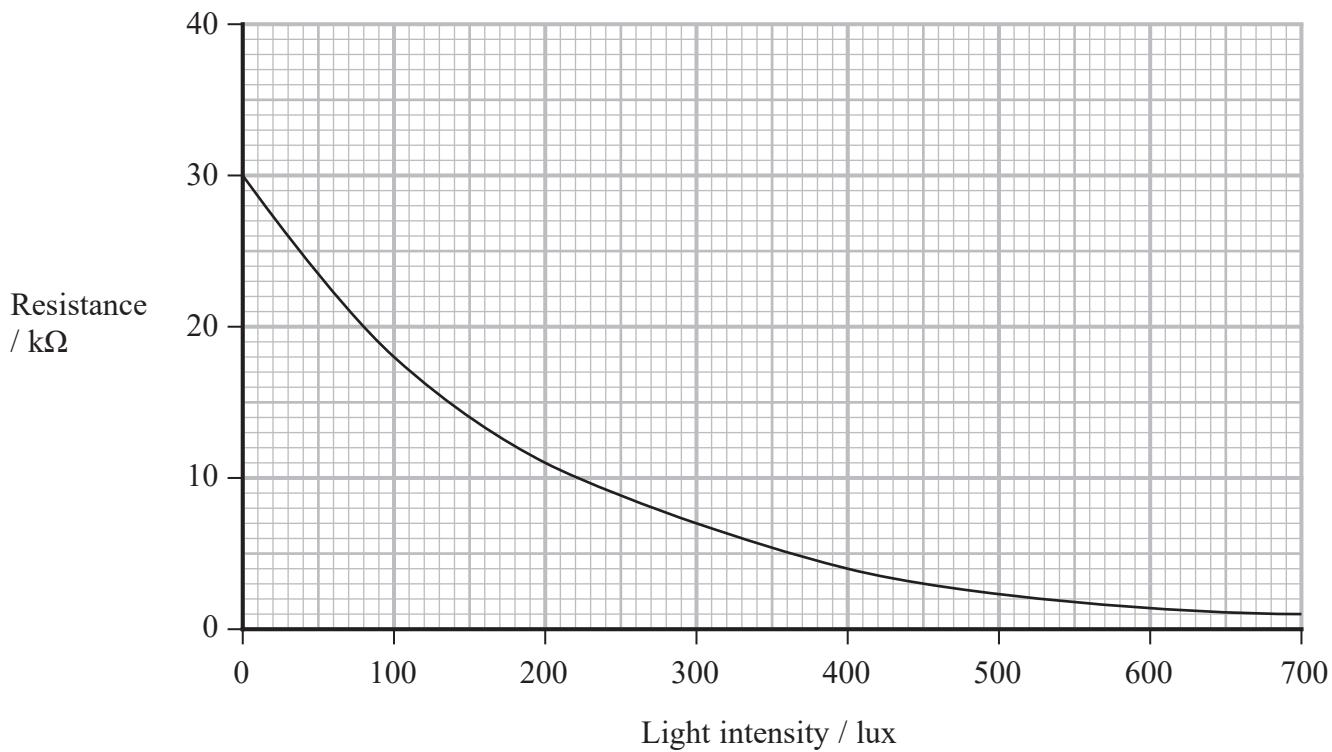
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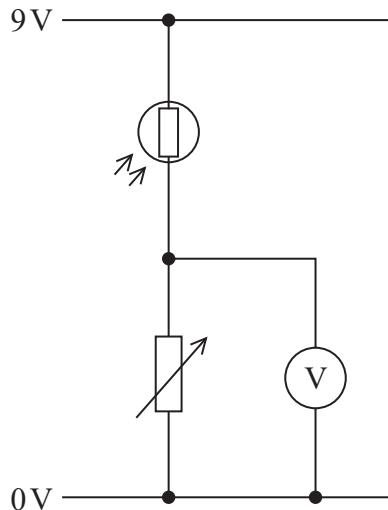


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11 The graph shows how the resistance of a light dependent resistor (LDR) varies with the incident light intensity, measured in lux.



A student used the LDR in the light-sensing circuit shown below.



(a) The student increased the resistance of the variable resistor whilst the light intensity was constant. The voltmeter recorded the potential difference across the variable resistor.

Explain what happened to the reading on the voltmeter.

(3)

(b) The variable resistor was set at a resistance of  $4.5\text{k}\Omega$ .

Determine the light intensity when the potential difference shown on the voltmeter was 2.5 V.

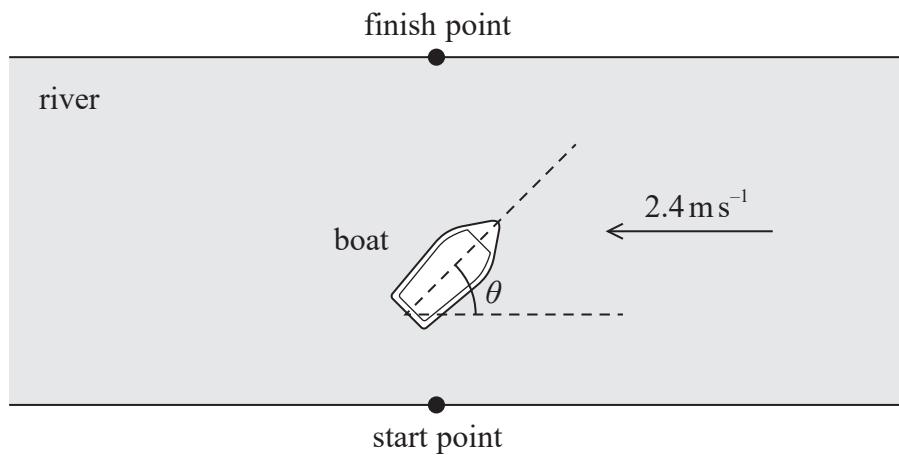
(3)

Light intensity = ..... lux

**(Total for Question 11 = 6 marks)**



12 A boat crosses a river, to a point on the bank directly opposite the starting point as shown. The velocity of the water in the river is  $2.4 \text{ m s}^{-1}$ .

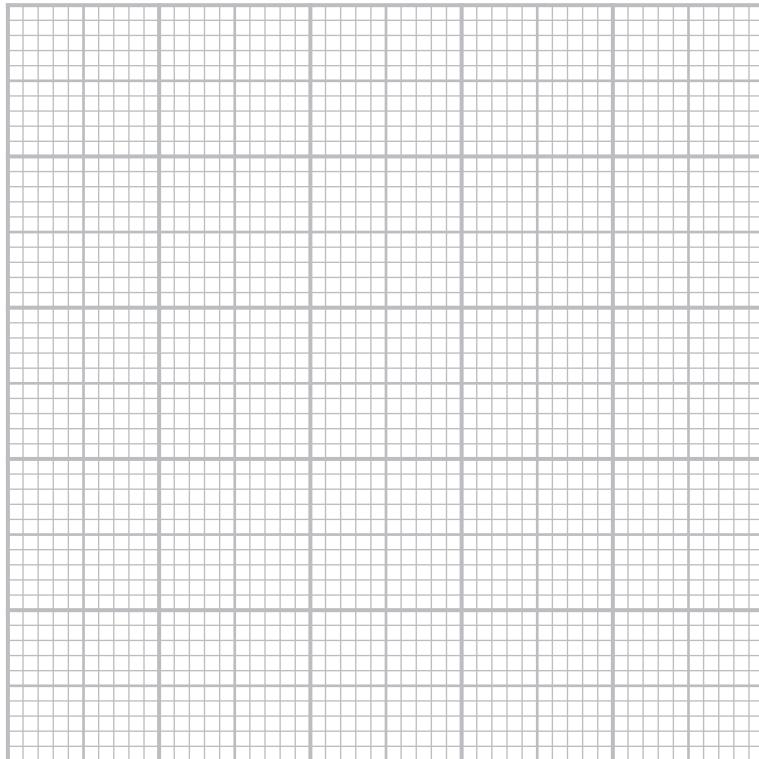


(a) The boat is steered at an angle  $\theta$  to the velocity of the water in the river in order to travel in a straight line across to the finish point.

The speed of the boat relative to the water is  $4.3 \text{ m s}^{-1}$ .

Determine the value of  $\theta$  by drawing a scaled vector diagram.

(3)



$$\theta = \dots$$



(b) The boat repeats the crossing, at the same speed, when the velocity of the water in the river is greater.

Explain how the time taken for the crossing will change.

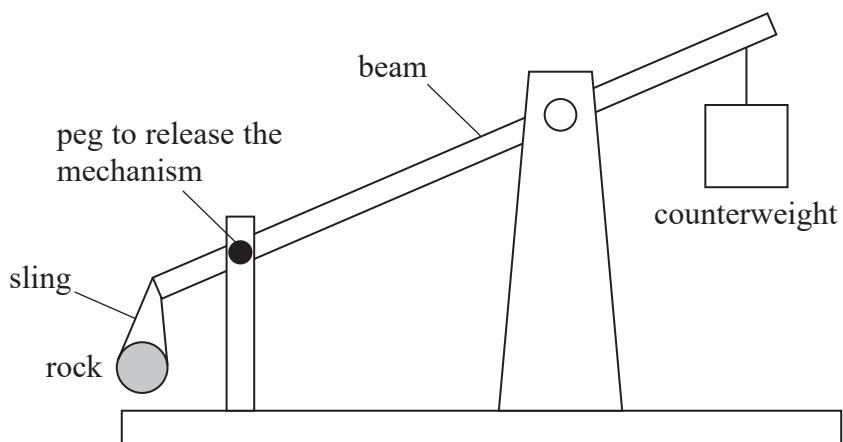
(3)

**(Total for Question 12 = 6 marks)**



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13 A trebuchet is a medieval catapult designed to project a rock over large distances. A simplified diagram of a trebuchet is shown.



The rock is held in a sling. When the peg is removed the counterweight falls and the rock is projected through the air.

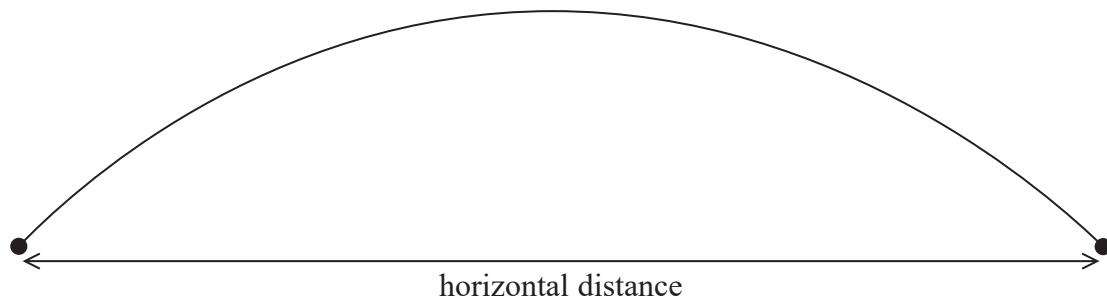
(a) A student assumes that all the gravitational potential energy transferred from the counterweight is transferred to the kinetic energy of the rock.

Give two reasons why this is not correct.

(2)



(b) The rock was projected with a velocity of  $41.5 \text{ m s}^{-1}$  at an angle of  $30^\circ$  to the horizontal. The diagram shows the flight of the rock after it has left the trebuchet.



The rock rises to a maximum height and then falls back to the same height as its release height.

Calculate the horizontal distance travelled by the rock in this time.

(4)

Horizontal distance = .....



(c) The mass of the counterweight was reduced. The trebuchet was then used to project the rock again.

Explain why the horizontal distance travelled by the rock decreases.

(5)

**(Total for Question 13 = 11 marks)**



\*14 A student is travelling forwards at constant speed on a skateboard.

The student jumps forward off the skateboard.



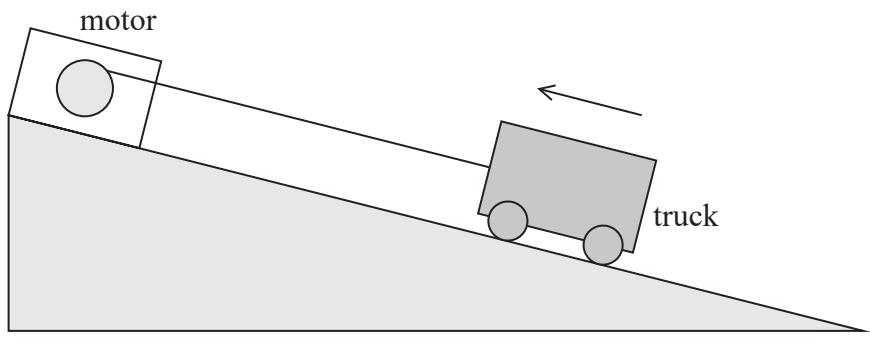
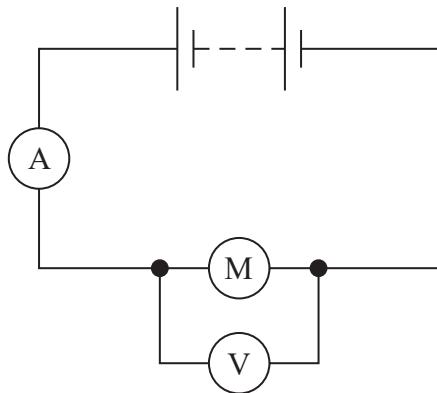
Explain how Newton's laws of motion apply to the student and the skateboard as he jumps forward off the moving skateboard.

**(Total for Question 14 = 6 marks)**



15 An electric motor is used to pull a truck up a slope at a constant speed.

The electric motor circuit includes a battery with no internal resistance, an ammeter and a very high resistance digital voltmeter as shown.



(a) The truck moves through a vertical height of 0.20 m in 15 s. The current in the motor is 8.1 mA and the potential difference across the motor is 12 V.

$$\text{mass of truck} = 550 \text{ g}$$

Calculate the efficiency of the motor.

(4)

Efficiency = .....



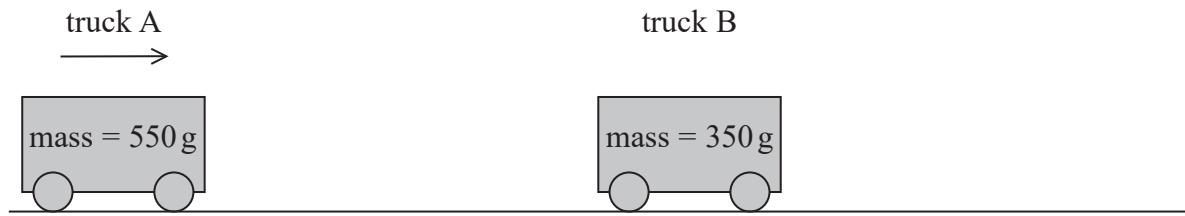
(b) The digital voltmeter is replaced with an analogue voltmeter with much less resistance.

Deduce how this will affect the efficiency of the motor circuit.

(4)



(c) The string pulling the truck was cut. The truck (A) travelled down the slope onto a horizontal surface and collided with a second truck (B), which was stationary, as shown.



The velocity of truck A just before the collision was  $5.4 \text{ m s}^{-1}$  and just after the collision was  $2.1 \text{ m s}^{-1}$ .

Determine the velocity of truck B after the collision.

(3)

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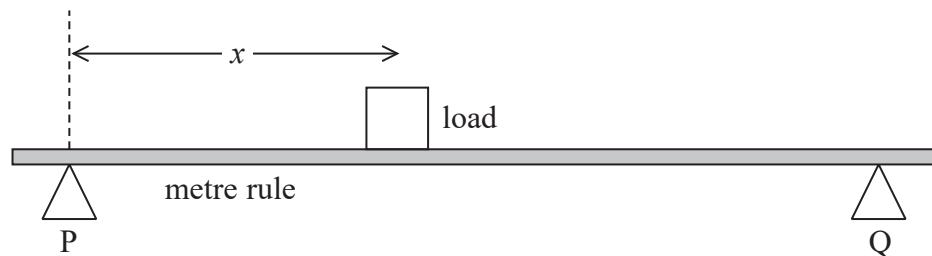
Velocity of truck B = .....

**(Total for Question 15 = 11 marks)**



16 A student investigated how the supporting forces on a bridge vary as traffic moves across the bridge.

The student made a simple model of a bridge using a metre rule. The metre rule rested on two supports, P and Q, as shown.



The upward force on the metre rule at P was  $F_p$ . The upward force on the metre rule at Q was  $F_q$ .

A load was placed on the metre rule a distance  $x$  from support P. Forces  $F_P$  and  $F_Q$  were measured for different values of  $x$ .

Explain how  $F_p$  and  $F_o$  changed as  $x$  was increased.

**(Total for Question 16 = 5 marks)**

**TOTAL FOR SECTION A = 59 MARKS**



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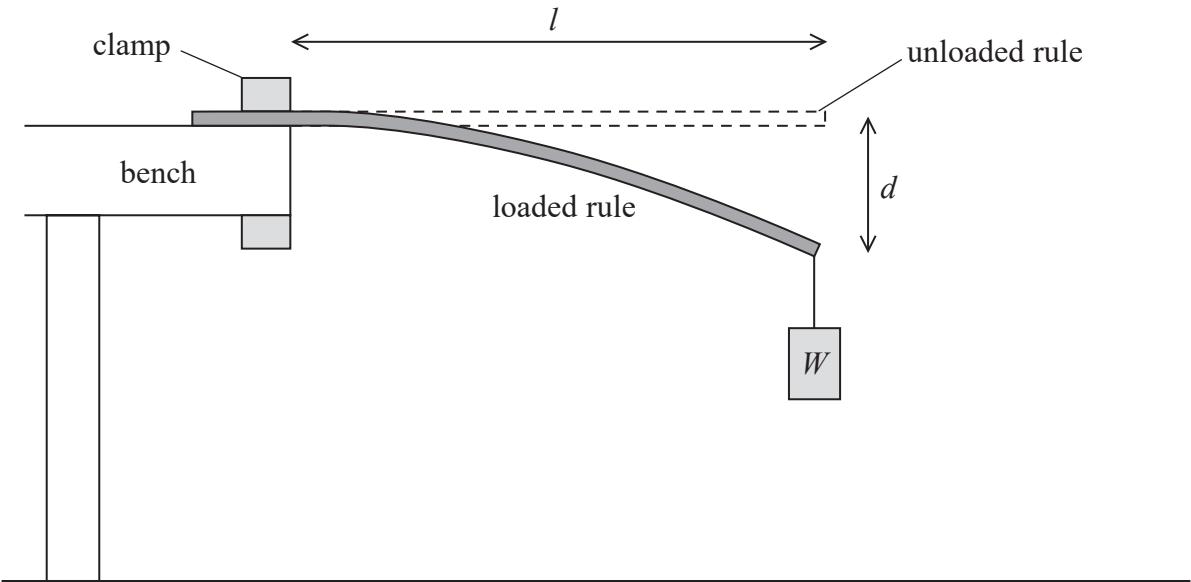
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## SECTION B

Answer ALL questions in the spaces provided.

17 The diagram shows a wooden metre rule which is clamped horizontally to a bench. The other end of the rule is loaded with a weight  $W$ . The length  $l$  of the metre rule between the clamp and  $W$  can be varied. The loaded end of the rule is displaced through a vertical distance  $d$  as shown.



A student investigated how  $d$  varied with  $l$ .

(a) Describe how the student should use set squares and a second metre rule to determine  $d$ . You may add to the diagram.

(2)

.....

.....

.....



(b) The student used the following equation for the relationship between the deflection  $d$  and the length  $l$ .

$$d = \frac{4Wl^3}{Ebt^3}$$

$E$  is the Young modulus of the wood,  $b$  is the width of the rule and  $t$  is the thickness of the rule.

(i) The student measured  $t$  several times and calculated its mean value  $\bar{t}$ .

$t / \text{mm}$				$\bar{t} / \text{mm}$
6.25	6.27	6.29	6.24	6.26

Calculate the percentage uncertainty in the thickness of the rule.

(2)

.....  
.....  
.....  
.....  
.....

Percentage uncertainty = .....

(ii) The student's results are shown in the table.

$l / \text{m}$	$d / \text{mm}$	
0.300	6	
0.400	18	
0.500	39	
0.600	68	
0.700	107	
0.800	166	

Plot a graph of  $d$  on the  $y$ -axis against  $l^3$  on the  $x$ -axis on the grid opposite.  
Use the additional column of the table for your processed data.

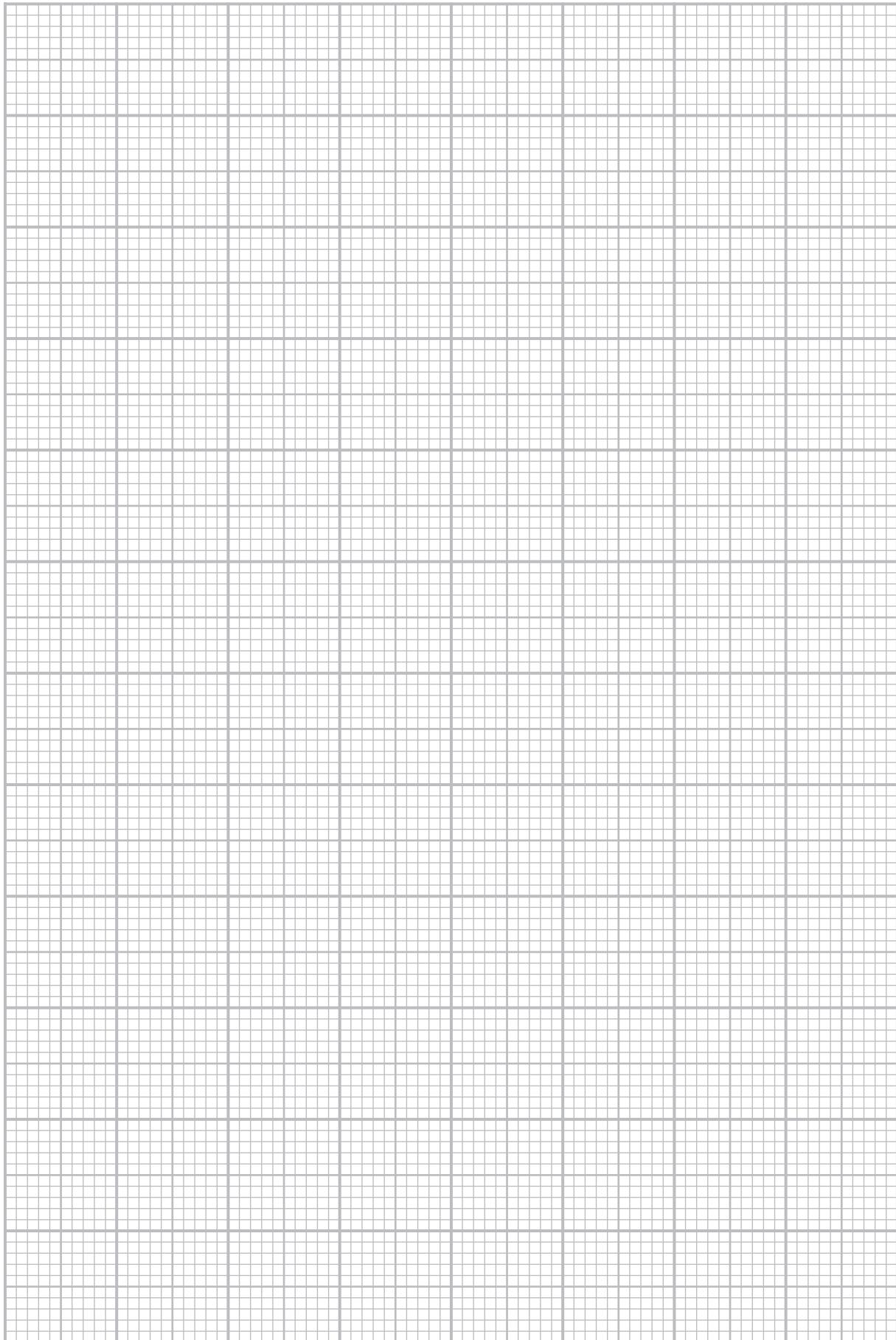
(5)



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(iii) The table gives the value of  $E$  for several types of wood.

Wood type	$E$ / GPa
Pine	6.9
Douglas fir	9.7
Spruce	11.1
Birch	13.9

Deduce the type of wood from which the rule was made.

$$W = 5.6 \text{ N}$$

$$b = 3.02 \text{ cm}$$

$$t = 6.26 \text{ mm}$$

(5)

(Total for Question 17 = 14 marks)



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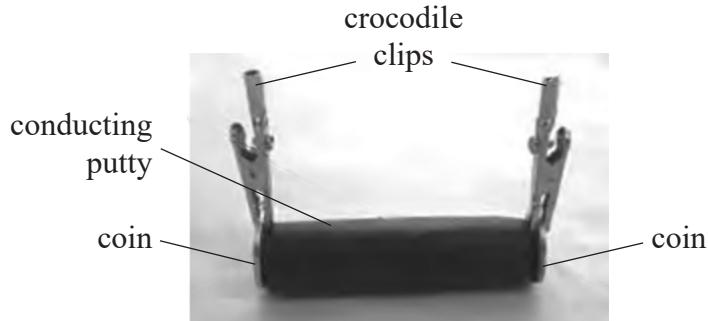
18 A student was given a block of conducting putty of mass 43 g.

(a) (i) Show that the volume of the block of conducting putty was about  $8 \times 10^{-6} \text{ m}^3$ .

density of conducting putty =  $5300 \text{ kg m}^{-3}$

(2)

(ii) The student formed the putty into a cylinder. Coins were pushed onto the ends of the cylinder as shown. The coins each had a crocodile clip attached and an ohmmeter was connected across the putty.



Determine the resistance of the cylinder of putty.

diameter of cylinder = 12 mm

resistivity of conducting putty =  $4.0 \times 10^{-3} \Omega \text{ m}$

(3)

Resistance = .....



(b) The student then made a cylinder that had a larger resistance.

Explain how the student used the putty to make a larger resistance.

(2)

**(Total for Question 18 = 7 marks)**

**TOTAL FOR SECTION B = 21 MARKS**

**TOTAL FOR PAPER = 80 MARKS**



P 6 9 4 4 0 R A 0 2 9 3 2

## List of data, formulae and relationships

Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19} \text{ C}$	
Electron mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$	
Electronvolt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$	

### Mechanics

Kinematic equations of motion

$$s = \frac{(u + v)t}{2}$$

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

### Forces

$$\Sigma F = ma$$

$$g = \frac{F}{m}$$

$$W = mg$$

$$\text{moment of force} = Fx$$

### Momentum

$$p = mv$$

### Work, energy and power

$$\Delta W = F\Delta s$$

$$E_k = \frac{1}{2}mv^2$$

$$\Delta E_{\text{grav}} = mg\Delta h$$

$$P = \frac{E}{t}$$

$$P = \frac{W}{t}$$

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

### Electricity

Potential difference

$$V = \frac{W}{Q}$$

Resistance

$$R = \frac{V}{I}$$

Electrical power and energy

$$P = VI$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

$$W = VIt$$

Resistivity

$$R = \frac{\rho l}{A}$$

Current

$$I = \frac{\Delta Q}{\Delta t}$$

$$I = nqvA$$



**Materials**

Density

$$\rho = \frac{m}{V}$$

Stokes' law

$$F = 6\pi\eta rv$$

Hooke's law

$$\Delta F = k\Delta x$$

Young modulus

$$\text{Stress } \sigma = \frac{F}{A}$$

$$\text{Strain } \varepsilon = \frac{\Delta x}{x}$$

$$E = \frac{\sigma}{\varepsilon}$$

Elastic strain energy

$$\Delta E_{\text{el}} = \frac{1}{2} F \Delta x$$

**Waves and particle nature of light**

Wave speed

$$v = f\lambda$$

Speed of a transverse wave on a string

$$v = \sqrt{\frac{T}{\mu}}$$

Intensity of radiation

$$I = \frac{P}{A}$$

Power of a lens

$$P = \frac{1}{f}$$

$$P = P_1 + P_2 + P_3 + \dots$$

Thin lens equation

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

Magnification for a lens

$$m = \frac{\text{image height}}{\text{object height}} = \frac{v}{u}$$

Diffraction grating

$$n\lambda = d \sin \theta$$

Refractive index

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$n = \frac{c}{v}$$

Critical angle

$$\sin C = \frac{1}{n}$$

Photon model

$$E = hf$$

Einstein's photoelectric equation

$$hf = \phi + \frac{1}{2}mv_{\text{max}}^2$$

de Broglie wavelength

$$\lambda = \frac{h}{p}$$



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